(LF) RF energy. Patrick et al. does **not**, however, disclose the use of both HF and LF RF, but states at column 1, lines 49-53:

> This RF energy may be low frequencies (below 550 KHz), high frequencies (13.56 MHz), **or** microwaves (2.45 GHz). A plasma etching system consists of **a radio frequency energy source and a pair of electrodes**. (Emphasis added)

The use of a singular "RF energy" and of the word "or" clearly indicates that Patrick et al. does not disclose the use of both HF and LF RF as alleged by the Examiner. As well known in the English language, the word "or" indicates an alternative while the word "and" indicates a combination. There is nothing in Patrick et al. that suggests using a combination of a HF RF electrode and a LF RF electrode. **Patrick et al. merely discloses the use of RF energy which may be LF, or alternatively be HF, or alternatively be microwaves.** Therefore, the Examiner's assertion that Patrick et al. discloses the use of a combination of LF and HF RF energy in a substrate processing system is without merit.

Moreover, Patrick et al. states at column 1, lines 51-53 that a plasma etching system "**consists of a radio frequency source and a pair of electrodes**." This indicates that a single RF source, which is LF, or HF, or microwaves, supplies the RF energy to both electrodes. This directly contradicts the Examiner's allegation that Patrick et al. discloses the use of a LF electrode and a HF electrode.

B. Patrick et al. Does Not Disclose the Use of Two Impedance Probes

Claim 11 recites two impedance probes. The Examiner maintains in ¶ 8 of the Office Action that Patrick et al. discloses the recited impedance monitor and processor. The RF parameter sensor 202 and discussed at column 7, lines 14-20, however, does not show two impedance probes. This also addresses the Examiner's assertion in ¶ 10 of the Office Action.

Furthermore, the two impedance probes as recited in claim 11 are novel and produce new and unobvious results. Measuring the impedance separately at the HF electrode and at the LF electrode can provide important information regarding the system

and the process. For instance, the specification at page 25, line 25 to page 27, line 14 (Figs. 8-10) describes the use of independent impedance measurements at the HF and LF electrodes in conjunction with other measurements such as phase angle and current intensities to analyze the effects on ion bombardment, wet etch rate, and other film properties. Thus, the claimed system produces new and unobvious results.

The presence of new and unobvious results provides an additional and independent ground for distinguishing over the cited art. The use of two impedance probes is neither taught nor suggested in the cited references. This claimed feature clearly distinguishes over the cited art, and addresses the concern raised in ¶ 11 of the Office Action.

C. The HF and LF Electrodes Distinguish over the Cited Art

The Examiner alleges in ¶ 9 of the Office Action that the use of the HF electrode and the LF electrode does not structurally distinguish over the prior art. Applicants respectfully submit that the terms HF and LF are not merely functional terms, but do structurally distinguish over the prior art. To more particularly point out and distinctly claim the invention, Applicants have amended claims 11, 16, and 20 to recite that the plasma power source comprises a high frequency power supply coupled with the HF electrode and a low frequency power supply coupled with the LF electrode.

D. Boys et al. Does Not Disclose the Use of Two Impedance Probes

The Examiner alleges in ¶ 12: "Applicant's contention that `Boys et al also fails to disclose or suggest the impedance monitor and processor as recited in claim 11 from which claims 5 and 27-29 depend...' is again grossly inaccurate." Yet, the Examiner concedes in the same ¶ 12 that Boys et al. does not teach the use of two impedance probes. The Examiner appears to rely on Patrick et al. for the disclosure of two impedance probes. As discussed above, nothing in Patrick et al. teaches or suggests the use of two impedance probes. Thus, Applicants' argument is sound.

E. Patrick et al. Does Not Disclose the Use of Different Capacitors

In ¶ 13 of the Office Action, the Examiner states that "it remains the Examiner's opinion that Patrick et al's matching network (120; column 6, lines 59-67)

has variable capacitors (106, 108) that are electrically and controllably coupled to the processor wherein the processor (204) adjusts a capacitance level of the variable capacitor(s) to vary the impedance of the plasma in response to an output of the impedance monitor (claim 5)." The Examiner seems to make the same point in ¶ 15 of the Office Action.

The Examiner appears to have misunderstood Applicants' statement. Applicants do not argue that Patrick et al.'s matching network does not contain variable capacitors. Instead, Applicants' point is that Patrick et al. does not disclose a matching network having capacitors that are different than the variable capacitor which is electrically coupled to the chamber and controllably coupled to the processor wherein the processor adjusts a capacitance level of the variable capacitor to vary the impedance of the plasma in response to an output of the impedance monitor, as recited in claim 16.

II. Rejections Under 35 U.S.C. § 103(a)

A. Claims 3-6, 11-14, 19, 21, 23, and 27-29

Independent claim 11 and claims 3, 4, 6, 12-14, 19, 21, and 23 depending therefrom stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Ohmi in view of Patrick et al.

Claim 11 recites that the impedance monitor comprises a first impedance probe electrically coupled to the HF electrode to measure the impedance at the HF electrode and a second impedance probe electrically coupled to the LF electrode to measure the impedance at the LF electrode. A processor is coupled with the impedance monitor for adjusting processing conditions of the deposition chamber based on measurements by the first impedance probe and the second impedance probe. Applicants believe claim 11 is patentable over the references because, for instance, they do not teach or suggest the recited impedance monitor and processor.

The Examiner alleges that Ohmi discloses an LF electrode (104) and an HF electrode (107). Applicants note that Ohmi discloses a "first high-frequency power source" and a "second high-frequency power source" (see Abstract; col. 6, line 62, to col.

7, line 6). The electrode (104) is a second high-frequency electrode at a frequency of 100 MHz, **not** an LF electrode.

Moreover, Ohmi does not teach or suggest an impedance monitor comprising a first impedance probe electrically coupled to the HF electrode to measure the impedance at the HF electrode and a second impedance probe electrically coupled to the LF electrode to measure the impedance at the LF electrode. The Examiner alleges that Patrick et al. discloses measuring the chamber impedance. The Examiner concedes that Patrick et al. does not disclose the use of a substrate holder as a low frequency (LF) electrode and a different high frequency (HF) electrode. The Examiner alleges, however, that Patrick et al. discusses applying either or both HF or LF power to the chamber electrodes, and that Patrick et al. discloses measuring the chamber impedance.

Applicants note that Patrick et al. at column 1, lines 49-53 states: "This RF energy may be low frequencies (below 550 KHz), high frequencies (13.56 MHz), or microwaves (2.45 GHz)." As explained above, Patrick et al. clearly does **not** disclose the use of both HF RF energy and LF RF energy as alleged by the Examiner.

In short, nothing in Ohmi and Patrick et al. teaches or suggests first and second impedance probes to measure impedance at the HF and LF electrodes, and a processor for adjusting processing conditions based on the measurements.

Furthermore, the two impedance probes as recited in claim 11 are novel and produce new and unobvious results. Measuring the impedance separately at the HF electrode and at the LF electrode can provide important information regarding the system and the process. For instance, the specification at page 25, line 25 to page 27, line 14 (Figs. 8-10) describes the use of independent impedance measurements at the HF and LF electrodes in conjunction with other measurements such as phase angle and current intensities to analyze the effects on ion bombardment, wet etch rate, and other film properties. Thus, the claimed system produces new and unobvious results.

For at least the above reasons, Applicants respectfully submit that independent claim 11, and claims 3, 4, 6, 12-14, 19, 21, and 23 depending therefrom, are patentable.

Claims 5 and 27-29 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Ohmi in view of Patrick et al., and further in view of Boys et al. The Examiner asserts that it would have been obvious to consider the pressure control system as allegedly described in Boys et al. to be an obvious extension to the Patrick et al. control system and impedance data collection and processing.

Applicants note that Boys et al. does not cure the defects of the other references since Boys et al. also fails to disclose or suggest the impedance monitor and processor as recited in claim 11 from which claims 5 and 27-29 depend. Moreover, claim 27 recites that the processor is configured to adjust a pressure in the deposition chamber based on measurements by the first impedance probe and the second impedance probe. Claim 28 recites that the processor is configured to adjust at least one of a high frequency RF power level of the power source and a low frequency RF power level of the power source, based on measurements by the first impedance probe and the second impedance probe. Claim 29 recites that the processor is configured to adjust a setting of the impedance tuner based on measurements by the first impedance probe and the second impedance probe. These features are completely absent from Boys et al. Therefore, claims 5 and 27-29 are patentable.

B. <u>Claims 16, 24, and 30</u>

Independent claim 16 and claim 24 depending therefrom stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Ohmi in view of Patrick et al. Claim 30 depends from claim 24, and stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Ohmi in view of Patrick et al., and further in view of Boys et al.

Applicants respectfully assert that claims 16 and 24 are patentable because, for instance, the references do not disclose or suggest the variable capacitor and matching network as recited in claim 16 from which claim 24 depends. Claim 30 depends from claim 24, and further recites that the computer processor is configured to adjust a pressure in the deposition chamber based on measurements by the first impedance probe and the second impedance probe, which is neither taught nor suggested in the references.

The Examiner alleges that Patrick et al. discloses variable capacitors (106, 108) and matching network (120; Fig. 2A) suitable for use in the matching circuit of Ohmi. Patrick et al. discloses a matching network (120) having variable capacitors (106, 108). It does **not** teach or suggest a matching network coupled to a high frequency RF generator and the gas manifold, wherein the matching network has capacitors that are different than the variable capacitor which is electrically coupled to the chamber and controllably coupled to the processor wherein the processor adjusts a capacitance level of the variable capacitor to vary the impedance of the plasma in response to an output of the impedance monitor. Moreover, the Examiner has not identified any suggestion in the references to combine Ohmi and Patrick et al., or how the variable capacitors and matching network of Patrick et al. can be adapted in the matching circuit of Ohmi.

For at least the foregoing reasons, claims 16, 24, and 30 are patentable.

C. Claims 20 and 26

Independent claim 20 and claim 26 depending therefrom stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Ohmi in view of Patrick et al.

Applicants respectfully assert that claims 20 and 26 are patentable because, for instance, the references do not disclose or suggest the variable capacitor and matching network as recited in claim 20 from which claim 26 depends. Not only is there no motivation to combine these references, but neither references teach or suggest a matching network having capacitors that are different than the variable capacitor which is electrically coupled to the chamber and controllably coupled to the processor wherein the processor adjusts a capacitance level of the variable capacitor to vary the impedance of the plasma in response to an output of the impedance monitor.

For at least the foregoing reasons, claims 20 and 26 are patentable.

## CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance and an action to that end is urged. If the

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Examiner believes a telephone conference would aid in the prosecution of this case in any way, please call the undersigned at 650-326-2400.

Respectfully submitted,

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## VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Please amend claims 11, 16, and 20 as follows.

11. (Thrice amended) A substrate processing system comprising:

a deposition chamber comprising a reaction zone;

a substrate holder that positions a substrate in the reaction zone;

said substrate holder comprising a low frequency (LF) electrode;

a gas distribution system that includes a gas inlet manifold for supplying one or more process gases to said reaction zone;

said gas inlet manifold comprising a high frequency (HF) electrode;

a plasma power source for forming a plasma within the reaction zone of said deposition chamber, the plasma power source comprising a high frequency power supply coupled with the HF electrode and a low frequency power supply coupled with the LF electrode;

an impedance monitor comprising a first impedance probe electrically coupled to said high frequency electrode to measure the impedance at the HF electrode and a second impedance probe electrically coupled to said low frequency electrode to measure the impedance at the LF electrode; and

a processor coupled with the impedance monitor for adjusting processing conditions of the deposition chamber based on measurements by the first impedance probe and the second impedance probe.

16. (Amended) A substrate processing system comprising:

a deposition chamber comprising a reaction zone;

a substrate holder that positions a substrate in the reaction zone;

said substrate holder comprising a low frequency (LF) electrode;

a gas distribution system that includes a gas inlet manifold for supplying one or more process gases to said reaction zone;

said gas inlet manifold comprising a high frequency (HF) electrode;

a plasma power source for forming a plasma within the reaction zone of said deposition chamber, the plasma power source comprising a high frequency power supply coupled with the HF electrode and a low frequency power supply coupled with the LF electrode;

an impedance monitor electrically coupled to said high frequency electrode and said low frequency electrode;

a computer processor communicatively coupled to said impedance monitor so that said computer processor receives as an input the measured impedance level of said plasma;

a variable capacitor electrically coupled to said chamber and controllably coupled to said processor wherein said processor adjusts a capacitance level of said variable capacitor to vary the impedance of said plasma in response to an output of said impedance monitor; and

a matching network electrically coupled to a high frequency RF generator and said gas manifold, wherein said matching network has capacitors that are different than said variable capacitor.

20. (Four times amended) A substrate processing system comprising:

a deposition chamber comprising a reaction zone;

a substrate holder that positions a substrate in the reaction zone;

said substrate holder comprising a low frequency (LF) electrode;

a gas distribution system that includes a gas inlet manifold for supplying one or more process gases to said reaction zone;

said gas inlet manifold comprising a high frequency (HF) electrode;

a plasma power source for forming a plasma within the reaction zone of said deposition chamber, the plasma power source comprising a high frequency power supply coupled with the HF electrode and a low frequency power supply coupled with the LF electrode;

an impedance monitor electrically coupled to said high frequency electrode and said low frequency electrode, said impedance monitor including an impedance monitor variable capacitor;

a processor communicatively coupled to said impedance monitor for receiving as an input a measured impedance level of said plasma;

a variable capacitor electrically coupled to said LF electrode and controllably coupled to said processor wherein said processor adjusts a capacitance level of said variable capacitor to vary the impedance of said plasma in response to an output of said impedance monitor; and

a matching network coupled between a low frequency RF generator and said variable capacitor, wherein said matching network includes capacitors that are different than said variable capacitor.